Title: The 3M Olympics (Mean, Median, Mode)

Brief Overview:

These activities will give the student a better understanding of measuring length using metric units and calculating measures of central tendency. The student will also understand why different measures of central tendency are favored over others in analyzing data. Graphing skills will also be emphasized.

NCTM 2000 Principles for School Mathematics:

• **Equity:** *Excellence in mathematics education requires equity - high expectations and strong support for all students.*

• **Curriculum:** *A curriculum is more than a collection of activities: it must be coherent, focused on important mathematics, and well articulated across the grades.*

• **Teaching:** *Effective mathematics teaching requires understanding what students know and need to learn and then challenging and supporting them to learn it well.*

• **Learning:** *Students must learn mathematics with understanding, actively building new knowledge from experience and prior knowledge.*

• **Assessment:** *Assessment should support the learning of important mathematics and furnish useful information to both teachers and students.*

• **Technology:** *Technology is essential in teaching and learning mathematics; it influences the mathematics that is taught and enhances students' learning.*

Links to NCTM 2000 Standards:

• **Content Standards**

Number and Operations
Students will be able to use the processes of addition and division (metric units) to calculate measures of central tendency.

Measurement
Students will demonstrate and apply concepts of metric measurement. They will estimate and verify their measurements. They will also apply measurement to real-world problems.

Data Analysis and Probability
Students will demonstrate their ability to collect, organize, and display data on a graph, and will interpret information obtained from the graph.

- **Process Standards**

  Reasoning and Proof
  Students will use reasoning skills when choosing the appropriate measure of central tendencies.

  Communication
  Students will write a justification about which graph would be an appropriate representation of the set of data.

  Connections
  Students will make connections with the metric measurements in the classroom to real life situations.

  Representation
  Students will represent their measures of central tendency on bar graphs.

Links to MSDE Writing Learning Outcomes:

- **Writing to Inform**
  Students will demonstrate the ability to write effectively to inform by justifying their choices of central tendency to be represented in a graph.

Grade/Level:

   Grades 6-7, beginning of year, low to average ability

Duration/Length:

   Five (5) 45 minute periods

Prerequisite Knowledge:

   Students should have working knowledge of the following skills:

- Estimating, rounding, and place value
- Using computational skills in whole numbers and decimals

Student Outcomes:

   Students will:

- choose an appropriate metric unit of measure.
- measure lengths to the nearest millimeter, centimeter, and meter.
- use computational skills to calculate mean, median, and mode.
- collect, organize, and represent data.
- analyze data to decide an appropriate method of measuring central tendency.
- write to inform for the student school paper.

Materials/Resources/Printed Materials:

- Metric ruler, and metric tape measures
- Large marshmallows, sandwich cookies, and peanuts (in shell)
  (Plastic straws, mini-cookies, and cotton balls may be used in confined areas.)
- Teacher and student resource sheets (provided here)
- Masking tape (for starting point)

Development/Procedures:

- **Day 1**
  Introduce the lesson with a discussion of the history of the Olympics, <u>Teacher Resource Sheet #1</u>. Ask students where it occurred, when, and what kind of events were held. Compare the Greek Olympics to the Olympics of today, similarities and differences. A brief history is included here for use by the teacher.

  Discuss how the Olympic events are measured using the metric system in order to determine the winner. The metric system is used today as the universal system of measurement. Hand out <u>Student Resource Sheet #1</u> and discuss metric units and their appropriate uses. Have the students work in pairs to complete the worksheet.

  During the last 5 - 10 minutes of class, divide the class into four to six groups of five students for the Olympic Trials to be held over the next three days. Explain the procedure for the three contests: the Cookie Roll, the Marshmallow Toss, and the Peanut Flick.

- **Day 2**
  Have the students sit with the appropriate Olympic Team. Students will be handed <u>Student Resource Sheet #2</u>, <u>Directions for the Olympic Trials Sheet</u> and <u>Student Resource Sheet #3, Olympic Trial Recording Sheet</u>. Review the procedures again with the class. The Cookie Roll event will be done first.

  The students will return to their seats and teachers will model how to calculate a mean of sample data. Using the team's trial data, they will calculate their team's mean. The teacher will use the overhead to collect the mean calculated by each team.
  The teacher will discuss how to set up a bar graph and demonstrate with random data. Each group will use the class results to draw a bar graph on graph paper. Use the y axis for the mean and the x axis as the team number.

- **Day 3**
  Do the second event, the Peanut Flick, following the directions sheet. Have the students return to their seats and demonstrate mode and review the mean. Have the class calculate the mean and mode for each of the teams' data, then share their data with the rest of the class. Now graph the mean and mode as a double bar graph. Use the same x and y axes as before.

- **Day 4**
  Do the Marshmallow Toss, using the directions sheet. Explain the median to the class. Have each team calculate their own median., mode, and mean. Have the class share their information and then have them display the data on a triple bar graph. Explain that mode is preferable to mean and/or median. when the data item that occurs the most is important. Some sets of data do not include a mode. The teacher will discuss and compare how outliers can shift the data. Mean can be influenced by one or two outliers and therefore median might be the more representative of the central tendency. Have the students look at their graphs and decide if one measure is more representative than another.

- **Day 5**
  Teacher will pass out <u>Student Resource Sheet #4, Performance Assessment</u> to be completed.

Performance Assessment:

Students will be assessed daily on performance. Both measuring accurately with the metric ruler and using computational skills to calculate mean, median, and mode will be used to evaluate each student's progress. Using data provided, students will choose the appropriate measure of central tendency and write their justification for it. A bar graph of a set of data will be represented. Scoring rubrics, <u>Teacher Resource Sheet #2</u>, and a grading sheet for this activity are included in the attached pages.

Extension/Follow Up:

Students can be assigned a particular Olympic sport, and do research on an athlete preparing for the Event. An oral presentation can be assigned, along with a written assignment. Compare the amount of Olympic medals different countries have won on a line plot/bar graph.

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History Of Olympics

The first Olympics were held in Olympia, Greece in the year 776 B.C. It was a running event called the stade, which was approximately 200 meters. The winner of the event was presented a crown of ivy to wear. Only men were allowed to compete, and they were naked.

More events were added as the years past. By 400 B.C. it became a festival of sports and entertainment. The Romans put a halt to this celebration, because they felt it was a pagan worship. Then, in 1896, athletes from 13 countries were sent to Athens to compete in the modern Olympics. Baron Pierre de Coubertin is the man known as "The Father of the Modern Olympic Games".

Olympic games in the ancient times were held to worship and honor the Gods. Modern Olympics are held as a friendly competition between nations.

References:

Math+Science: A Solution, 1987 Aims Education Foundation, page 21-23, 1987

Internet source: http:/infoplease.lycos.com

Measuring with Metric Units
Meters, Centimeters, and Millimeters

1 meter (m) = 100 centimeters (cm) = 1,000 millimeters (mm)
1 meter is about the width of the classroom door

1 centimeter (cm) = 1/100 of a meter or .01 m
1 centimeter is about the width of your pinky finger

1 millimeter (mm) = 1/1,000 of a meter or .001 m
1 millimeter is about the thickness of a dime

1 kilometer (km) = 100 m
1 kilometer is about the distance of 6 city blocks

Estimate the length of each line to the nearest centimeter. Then measure each to the nearest centimeter. Finally, tell the length of each line to the nearest millimeter.

1. _____

2. _____

3. _____

4. _____

5. ___

	Estimate (cm)	Measure (cm)	Measure (mm)
1.	_____	_____	_____
2.	_____	_____	_____
3.	_____	_____	_____
4.	_____	_____	_____
5.	_____	_____	_____

Fill in the blank.

1. 0.5 cm = _____ mm   **2**. 1 cm = _____ mm   **3**. 1.5 cm = _____ mm

4. 7.5 cm = _____ mm   **5**. 10 mm = _____ cm   **6**. 65 mm = _____ cm

7. 2 m = _____ cm   **8**. 3.5 m = _____ cm   **9**. 50 cm = _____ m

10. 150 cm = _____ m   **11**. 75 cm = _____ m   **12**. 4.5 m = _____ cm

13. 2 km = _____ m   **14**. 500 m = _____ km   **15**. 0.5 km = _____ cm

What unit would you use to measure the following items? Choose the appropriate unit.
Use **kilometers (km), meters (m), centimeters (cm),** or **millimeters (mm)**.

1.)   length of a relay baton   _____

2.)   thickness of a gold metal   _____

3.)   height of a bar for the high jump   _____

4.)   distance of a marathon run   _____

In the classroom, use a meter stick or tape measure to measure in **cm** and **mm** the
dimensions of your math textbook.

height: _____ (how tall the book is)

width: _____ (how wide the book is)

thickness: _____ (how thick the book is)

Now measure your desk using meters and centimeters as your units.

height: _____ (from floor to top of desk)

length: _____ (how long the desk is)

width: _____ (how wide the desk is)

Measuring with Metric Units
Meters, Centimeters, and Millimeters   **KEY**

1 meter (m) = 100 centimeters (cm) = 1,000 millimeters (mm)
1 meter is about the width of the classroom door

1 centimeter (cm) = 1/100 of a meter or .01 m
1 centimeter is about the width of your pinky finger

1 millimeter (mm) = 1/1,000 of a meter or .001 m
1 millimeter is about the thickness of a dime

1 kilometer (km) = 100 m
1 kilometer is about the distance of 6 city blocks

Estimate the length of each line to the nearest centimeter. Then measure each to the nearest centimeter. Finally, tell the length of each line to the nearest millimeter.

1. _____

2. _____

3. _____

4. _____

5. ____

*** **Record your measurements here:**

	Estimate (cm)	Measure (cm)	Measure (mm)
1.	_____	_____	_____
2.	_____	_____	_____
3.	_____	_____	_____
4.	_____	_____	_____
5.	_____	_____	_____

Fill in the blank.

1. 0.5 cm = **5** mm   **2**. 1 cm = **10** mm   **3**. 1.5 cm = **15** mm

4. 7.5 cm = **75** mm   **5**. 10 mm = **1** cm   **6**. 65 mm = **6.5** cm

7. 2 m = **200** cm   **8**. 3.5 m = **350** cm   **9**. 50 cm = **0.5** m

10. 150 cm = **1.5** m   **11**. 75 cm = **0.75** m   **12**. 4.5 m = **450** cm

13. 2 km = **2,000** m   **14**. 500 m = **0.5** km   **15**. 0.5 km = **50,000** cm

What unit would you use to measure the following items? Choose the appropriate unit of measure. Use **kilometers (km), meters (m), centimeters (cm),** or **millimeters (mm)**.

1.)   length of a relay baton: **cm**

2.)   thickness of a gold medal: **mm**

3.)   height of a bar for the high jump: **m**

4.)   distance of a marathon run: **km**

In the classroom, use a meter stick or tape measure to measure the dimensions of your math textbook in **cm** and in **mm** .

height: _____ (how tall the book is)

width: _____ (how wide the book is)

thickness: _____ (how thick the book is)

Now measure your desk using meters and centimeters as your units.

height: _____ (from floor to top of desk)

length: _____ (how long the desk is)

width: _____ (how wide the desk is)

Directions For Olympic Trials

Each team member must first estimate the distance they think they will get on the event of the day. This estimate should be shared with the group and each team member must record the estimates of their team mates on their own recording sheet. Then each team member must complete the event for the day and measure their own distance to the nearest centimeter (cm). The distance must be reported to the other team members and each member must record the result on their own recording sheet.
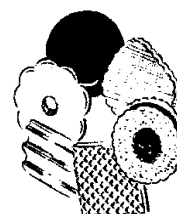
Cookie Roll

Place the cookie on its edge at the starting point. Roll the cookie. Measure the distance from the starting point to where the cookie stopped. Record the result.

Peanut Flick

Place the peanut on end at the starting point. As you hold the peanut on its end with your index finger, flick it with your other hand. Measure the distance from the starting point to where the peanut stopped. Record the result.

Marshmallow Toss

The marshmallow must be thrown like a shot put. The throwing arm must be bent back at the wrist,(like a waiter carrying a tray). Thrust the arm upward to launch the marshmallow. Make sure all students toss the marshmallow in the same manner. Measure the distance from the starting point to where the marshmallow stopped. Record the result.

Olympic Trials Recording Sheet

Team _____

Cookie Roll

Team Members	Estimate	Actual Distance	Group Mean
_____	_____	_____	_____
_____	_____	_____	
_____	_____	_____	
_____	_____	_____	
_____	_____	_____	

Peanut Flick

Team Members	Estimate	Actual Distance	Group Median
_____	_____	_____	_____
_____	_____	_____	
_____	_____	_____	Group Mean
_____	_____	_____	
_____	_____	_____	_____

Marshmallow Toss

Team Members	Estimate	Actual Distance	Group Mode
_____	_____	_____	_____
_____	_____	_____	Group Median
_____	_____	_____	
_____	_____	_____	_____
_____	_____	_____	Group Mean
			_____

Assessment: Calculating mean, median, mode, and evaluating the answers, along with bar graphing the data.

The school sponsored a Mini - Olympics between the sixth, seventh and eighth graders. You are a reporter for the school newspaper. You wish to report the average distance that a sixth grader jumps compared to the average distance a seventh and eighth grader jumps. Use the data below to calculate the mean, median, and mode and evaluate which one(s) would best represent the data for each grade.
 Include a bar - graph of the preferred central tendency for each grade (use the y axis for the distance and indicate the mean, median or mode for the three grades)

HIGH JUMP (cm)

Average:	Grade 6	Grade 7	Grade 8
Group # 1	140	155	70
Group # 2	60	125	155
Group # 3	130	140	150
Group # 4	120	150	145
Group # 5	130	130	210
Group # 6	125	145	160
Group # 7	135	135	165

1. MEAN _____ _____ _____

Explain how to calculate the mean _____

_____

2. MODE _____ _____ _____

Explain how to calculate the mode_____

_____

3. MEDIAN _____ _____ _____

Explain how to calculate the median_____

_____

4. Comparing your data, which one of the measures of central tendency would you
    want to use to represent each grade and why?

_____

_____

_____

_____

_____

_____

5. GRAPH:

-

-

-

-

-

-

-

-

-_____

Rubric For Assessment

1. **2 Points** - Correct mean calculated.
   - Grade 6 = 120 cm
   - Grade 7 = 140 cm
   - Grade 8 = 150.7 cm
   - Explanation should include adding up each group in the set of data and dividing that sum by the number of groups.

   1 Point - Correct mean calculated with a weak explanation or an error in calculation but a clear explanation.

   0 Points - Unclear explanation and calculation mistakes.

2. **2 Points** - Correct mode calculated.
   - Grade 6 = 130 cm
   - Grade 7 = none
   - Grade 8 = none
   - Explanation should include choosing the number that appears most often on the list of data.

   1 Point - Finding the correct mode along with an unclear explanation, or a clear explanation and the wrong mode.

   0 Points - The wrong mode and an unclear explanation.

3. **2 Points** - Correct median calculated.
   - Grade 6 = 130
   - Grade 7 = 140
   - Grade 8 = 155
   - Explanation should include ordering the data and finding the middle number.

   1 Point - Correct median found but explanation unclear, or a clear explanation but the wrong median given.

   0 Points - The wrong median given and an unclear explanation.

4. **2 Points** - Choosing the mean or the median for the data display with a clear explanation for the choice made.

   1 Point - Choosing the mean or the median for the data display but the explanation is weak.

   0 Points - Any other answer.

5. **2 Points** - Accurate display of data with title, axes labeled, and intervals spaced correctly.

   1 point - Accurate display without a title or label, or one inaccurate bar but the graph is titled and labeled.

   0 points - An inaccurate display of the data or missing both title and label.